9. **Background flow control test fails**
   a. Verify output of R4 at blended gas outlet (18 ±1 psi; 20 ±2 Lpm).
   b. If the unit has 107 software installed, complete the patient circuit through flow sensing device or disconnect proximal line.
   c. Verify electrical connections of flow solenoids at terminal block. (Use LED's on Alarm Driver PCA to determine which solenoids are active.)
   d. Calibrate individual flow restrictors.
   e. Replace applicable flow solenoids.
   f. Replace flow manifold.
10. **Ventilator rate control test fails**
   a. Replace Analog PCA.
   b. Replace Front Panel PCA.
   c. Replace Pressure Transducer PCA.
11. **Peak inspiratory pressure; high**
   a. Verify functionality of patient circuit.
   b. Refer to error codes in Section 9 for A01, A02 and A05.
   c. Check for water in proximal line (both patient circuit and internal).
   d. Check flow manifold for leaking solenoids.
   e. Check/replace diaphragm.
   f. Check/replace venturi block.
   g. Clean/replace SV10.
12. **Peak inspiratory pressure; low**
   a. Verify ventilator settings (inspiratory time and flow rate).
   b. Check for leaks in patient circuit.
   c. Make sure relief valve is fully clockwise.
   d. Check jet venturi nozzle and o-ring.
   e. Check venturi block's diaphragm seat for leaks or replace block.
   f. Check diaphragm for holes. Replace diaphragm.
   g. Check flow manifold for low flows (SV1, SV2 and SV3).
   h. Clean/replace SV10.
13. **Inspiratory time control test fails**
   a. Verify ventilator is not running on internal battery.
   b. Replace Front Panel PCA.

14. Duration of positive pressure test fails

a. Verify patient circuit connections.

b. Verify ventilator is not running on internal battery.

c. Replace SV10.

d. Replace Analog PCA.

e. Replace Front Panel PCA.

f. Replace Alarm Driver PCA.

15. Expiratory time/I:E ratio tests fails

a. Verify ventilator is not running on internal battery.

b. Replace Front Panel PCA.

16. Venturi control test fails (units with venturi needle valve only)

a. Verify functionality of patient circuit.

b. Verify connections of SV9.

c. Clean or replace exhalation block.

d. Clean or replace jet venturi nozzle/o-ring.

17. PEEP/CPAP control test fails; high/low

a. Verify functionality of patient circuit.

b. Verify operation of PEEP/CPAP potentiometer.

c. Check for excessive venturi (clean/replace SV9 or jet venturi nozzle/o-ring).

d. Clean or replace exhalation diaphragm.

e. Clean or replace exhalation block.

f. Calibrate PEEP system.

g. Replace PEEP regulator.

h. Clean or replace SV8. (Must recalibrate PEEP system.)

18. Oxygen blender test fails; high/low

a. Verify functionality of oxygen analyzer.

b. Check balance of air/oxygen regulators.

c. Check blender bleed for occlusion.

d. Calibrate or replace blender.

19. Oxygen blender potentiometer test fails

a. Check potentiometer harness.

b. Recalibrate / replace potentiometer.

20. Crossover test fails

- Replace CV5, leaking.

21. Air/oxygen crossover test fails

a. Verify Crossover regulator calibration.

b. Replace oxygen regulator assembly.

c. Replace CV5.

22. Blended gas outlet test fails

a. Verify output of R4 (18psi).

b. Clean or replace blended gas outlet restrictor.

23. Low inspiratory pressure alarm, audible and alarm silence test fails

a. Verify operation of audible alarm.

b. Check alarm wires.

c. Replace Alarm Driver PCA.

24. Low PEEP/CPAP alarm test fails

a. Check for water in proximal airway pressure line.

b. Replace Pressure Transducer PCA.

25. Obstructed tube alarm test fails

a. Check for water or occlusion in proximal airway pressure line.

b. Replace Pressure Transducer PCA.

26. High CPAP alarm test fails

a. Check for leaks in proximal airway pressure line.

b. Replace Pressure Transducer PCA.

27. Overpressure pop-off valve (relief valve) test fails

a. Check for debris in relief valve.

b. Replace relief valve.

28. Vent Inop test fails

- Replace Alarm Driver PCA.

29. Airway leak alarm test fails

- Replace Pressure Transducer PCA.

30. HFV rate control calibration and test fails (Infant *Star* 950)

a. Verify calibration of HFV rate knob.

b. Check for cuts on Analog Output cable.

c. Replace Front Panel PCA.

31. HFV flow test fails (Infant *Star* 950)

a. Verify operation of flow meter.

b. Verify relief valve position.

c. Verify output of HFV solenoids: SV11A,B - SV12A,B.

32. HFV amplitude test fails (Infant *Star* 950)

a. Verify condition of patient circuit.

b. Check for water or occlusion in proximal airway pressure line.

c. Replace Pressure Transducer PCA.

33. HFV PEEP/CPAP control test fails (Infant *Star* 950)

a. Verify condition of patient circuit, test lung, low compliance humidifier chamber, and exhalation diaphragm.

b. Check for water or occlusion in proximal airway pressure line.

c. Replace Pressure Transducer PCA.

d. Verify the calibration of venturi needle valve on SV9 (Infant *Star* 950 CE units).

e. Verify the flows of SV11A,B and SV12A,B on flow manifold.

f. Refer to PEEP/CPAP Control test item 17.

34. IMV + HFV Inadvertent PEEP test fails (Infant Star 950)

a. Verify condition of/replace patient circuit.

a. Check for water or occlusion in proximal airway pressure line.

b. Replace Pressure Transducer PCA.

c. Verify the calibration of venturi needle valve on SV9 (Infant *Star* 950 CE units).

d. Verify the flows of SV11A,B and SV12A,B on flow manifold.

e. Refer to PEEP/CPAP control test item 17.

35. Internal battery test fails

a. Verify battery is charging (check charging voltage).

b. Replace 10 V battery.

36. Hour meter test fails

a. Check hour-meter cable connections.

b. Replace hour meter. Replace MP2 PCA.

SECTION 6

Repair and Adjustment

6.1 Oxygen Regulator (R2) Adjustment

6.1.1 Tools, Equipment, and Supplies

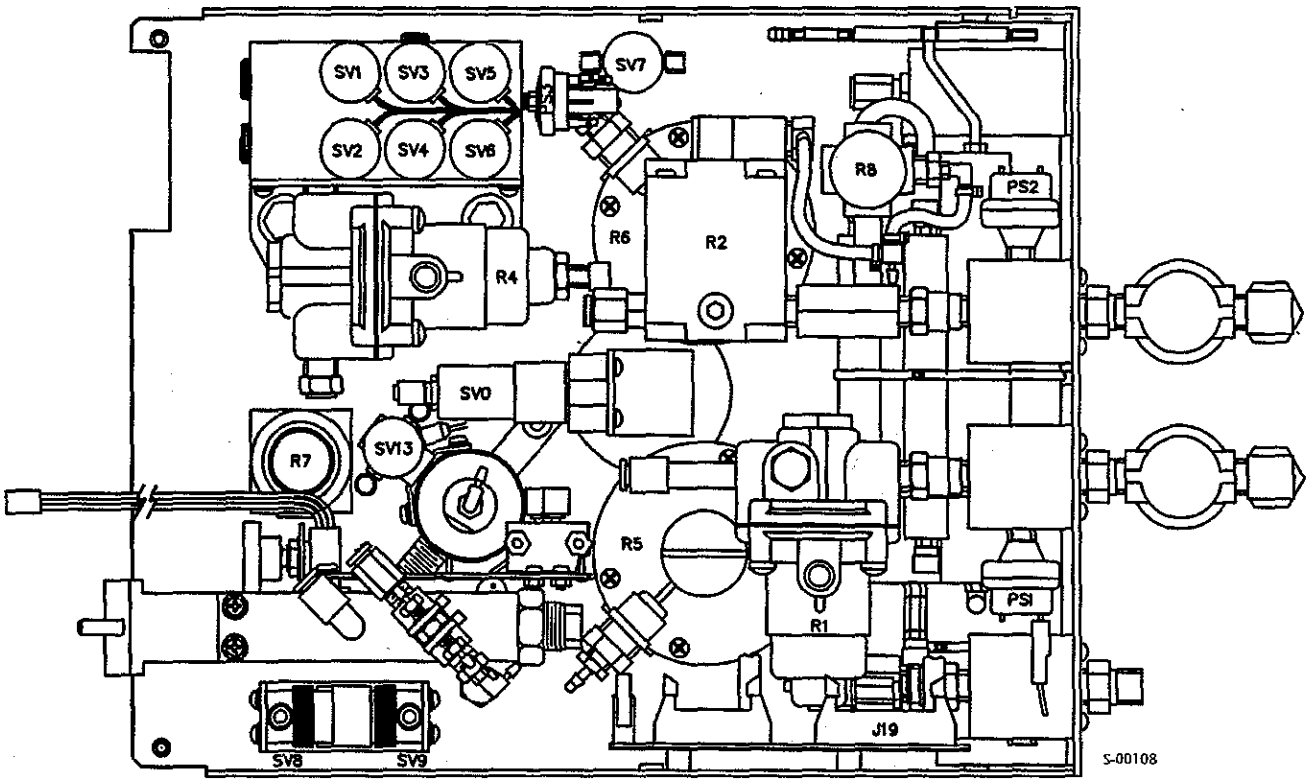
- -5 to +5 cmH_2O pressure gauge, Dwyer Capsuhelic, P/N – N-4300010 (or equivalent)
- 0 to 60 psi gauge
- high pressure tubing tee assembly, P/N – N-9710164
- adjuster tool, P/N – N-97101016
- tie wrap, small (4), P/N – N-3440008
- loctite torque seal
- 1/4 inch hollow set screw wrench
- room thermometer
- standard tool kit

Done if you replace the O_2 Regulator or Oxygen blender If oxygen test fails.

6.1.2 Balance Air and Oxygen Pressures

In order to obtain correct oxygen percentages, it is necessary to balance the air and oxygen pressures applied to the blender.

1. Place the ventilator on a wide workbench.
2. Remove the 6 screws securing the pneumatics cover to the base; then lift the cover and electrical head off and place it behind the pneumatics base (Figure 6-1).



38 PSI

Figure 6-1. Infant *Star* 500 Pneumatics Base Assembly

3. On the air regulator (R1), disconnect the hard polyvinyl tube by depressing the flange on the fitting and pulling the tube out. Cut and remove a small tie wrap if it is locking the flange. Connect a 0 to 60 psi gauge (psig) to R1.
4. Connect an air source (60 to 90 psi) to the *air* fitting on the back of the ventilator. Check the psig for a reading of 38 +1 psi. If the pressure is not within these limits, remove the pressure transducer PCA and adjust the air R1 screw.
5. Disconnect the air source to the ventilator. Cut the tie wrap, depress the flange and remove the air hard polyvinyl tube at the blender. In like fashion, remove the hard polyvinyl tube between oxygen regulator (R2) and blender (Figure 6-2).

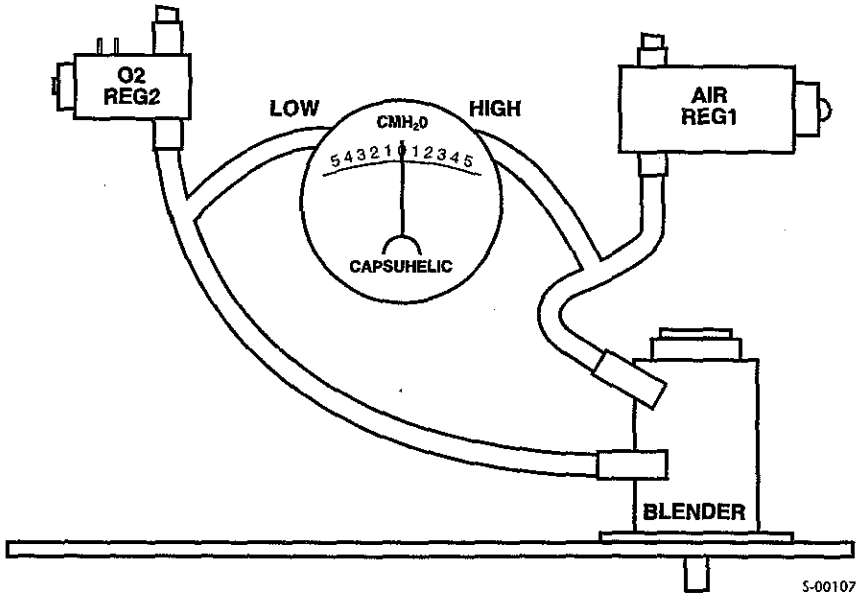


Figure 6-2. Air and Oxygen Pressures Applied to Blender

Tee the pressure gauge between the R1 and blender, and R2 and blender as shown in Figure 6-2.

NOTE:

When performing the following step, the two gas sources must be within 60 to 90 psi and set at the same pressure ±5 psi.

6. Connect the air source again to the air fitting on the back of the ventilator. Connect an oxygen source (or air for test purposes) to the oxygen fitting on the back of the ventilator.
7. Turn the O_2 % knob to 60.
8. Turn the ventilator ON, select CPAP, set Flow and Background Flow to 4 Lpm and PEEP to 0 cmH_2O. Compare the gauge readings with the calibration chart, verifying room temperature (Table 6-1).

NOTE:

- Allow sufficient time for the ventilator to be at room temperature if brought in from a cold area.
- The negative (-) readings to the left of zero (on the pressure gauge) represent the oxygen side whereas the positive readings to the right of zero represent the air side.

Caution

Do not adjust R2 at temperatures lower than 72 °F.

Table 6-1: Oxygen Regulator Calibration Chart

Room Temperature (°F)	Oxygen Regulator Adjustment (+0.2 cmH_2O)
72-74	-0.9
75-77	-0.5
78-80	-0.2
81-83	+0.2
84-86	+0.5

NOTE:
Do not perform oxygen percent test at this time.

9. If the pressure readings do not fall within the temperature ranges listed on the calibration chart (Table 6-1), R2 must be adjusted.

6.1.2.1 Oxygen Regulator (R2) Adjustment

1. Disconnect the air and oxygen sources.
2. Remove the pipe plug from R2 (Figure 6-3) and install an adjuster tool in its place.
3. Reconnect the air and oxygen sources. Apply identical pressures between 60 to 90 psi. Verify the gauge readings.

NOTE:
Turn the adjusting screw clockwise to increase the R2 output pressure.

4. Adjust R2 by pushing in and turning the adjuster tool shaft until the gauge reading is correct for the room temperature. When the reading is stable, use the previous calibration chart to verify the gauge reading.

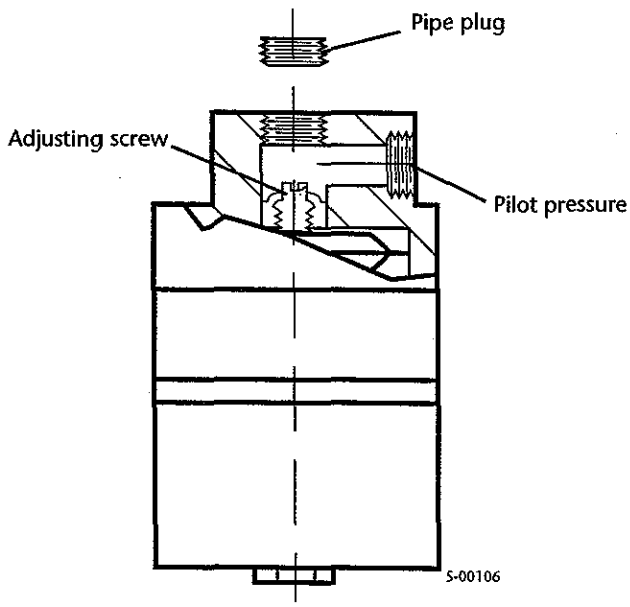


Figure 6-3. Removing Pipe Plug from Oxygen Regulator

5. Disconnect the air and oxygen sources and remove the adjuster tool.
6. Apply Dow Corning 732 multipurpose sealant to the pipe plug and reinstall finger tight.
7. Using a 1/4 inch set-screw wrench, finish tightening the adjuster plug 1/4 to 1/2 turn more.
8. Restore air and oxygen pressure and verify that the plug has not been installed too tight, causing the calibration to change. If the setting has changed, repeat Section 6.1.2.1.
9. Disconnect the air and oxygen pressure and the 2 high-pressure tee assemblies. Install the 2 hard polyvinyl tubes between the blender and oxygen regulator and the air regulator.

6.2 Check Valve (CV5) Leak Test and Safety Regulator (R8) Calibration

The Infant *Star* 500/950 ventilators continue to function with the loss of one source gas. An audible/visual alarm indicates which gas is lost. The patient is ventilated with the available gas. CV5 supplies air to the oxygen side of the system in the event of an oxygen loss. In the event of an air loss, R8 supplies a pilot pressure to the dome of R2 and oxygen to the air side of the system.

If 5.1.6 Fails 5.1.7

NOTE:
The operational pressure range is noted on the label affixed to the rear of the pneumatics module above the air/oxygen filters.

In normal operation, the air inlet regulator delivers 38 psi (33 psi for CE model 500) and the oxygen regulator (R2) is balanced to also deliver 38 psi (33 psi for CE model 500). The ventilator has a safety regulator (R8) set at 30 psi (29 psi for CE model 500). CV5 has a 5 1/2-pound cracking pressure to prevent the check valve from responding to normal line pressure variations.

NOTE:
Reference Figure 6-4 when performing this procedure.

1. Open the pneumatic compartment and connect an air and oxygen source that meets the requirements previously noted.
2. Disconnect the tube that comes from the CV5 and connects to the tee fitting at the air regulator outlet (test point 1 in Figure 6-4). When holding the tube underwater, there must not be a leakage of more than ten bubbles in 30 seconds. Block the fitting at the air regulator during this test. Reconnect the tube when CV5 meets specifications.
3. Remove air and oxygen pressure, disconnect the tube that connects to the air regulator brass fitting (test point 2 in Figure 6-4). Attach a 0 to 60 psi pressure gauge to this tube, and connect oxygen pressure only.
4. Set the ventilator O_2 control knob to 21%.
5. Adjust the safety regulator (R8) to show 30 psi ±1 (29 psi ±1 for CE model 500) on the pressure gauge.

NOTE:
When the inlet pressure is below 50 psi, the safety regulator (R8) outlet pressure will typically be above 30 psi. When the inlet pressure is above 50 psi, the R8 pressure will be below 30 psi. See Table 6-2 for variations. All readings shown are with no flow.

Table 6-2: Safety Regulator Outlet Pressure

Inlet Pressure (psig)	R8 Outlet Pressure (psig)	
	Infant *Star* 500/950	Infant *Star* 500 CE mark
40	33	32
45	32.5	31.5
50	30	29
55	29.5	28.5
60	29	28
65	28	27

6. Push red locking nut away from the knob and place tie wrap between them.
7. Disconnect the oxygen pressure. Remove pressure gauge and reconnect the tube to the R1 brass fitting.
8. Connect air pressure and check to verify that the R1 output is still at 38 psi (33) ±1. If not, adjust accordingly.
9. Disconnect the air and oxygen sources, then reconnect.
10. Repeat steps 3, 4, and 5 to confirm that the regulator settings have not changed.
11. Perform the ventilator Quick Checkout (see Section 3).
12. Run the ventilator for at least 6 hours and recheck the oxygen percentages. If the R2 drifts sufficiently to cause the oxygen percentages to be out of allowable tolerances, readjust R2 and run the ventilator for another 6 hours. If the oxygen percentage is still not stable, replace the oxygen regulator.

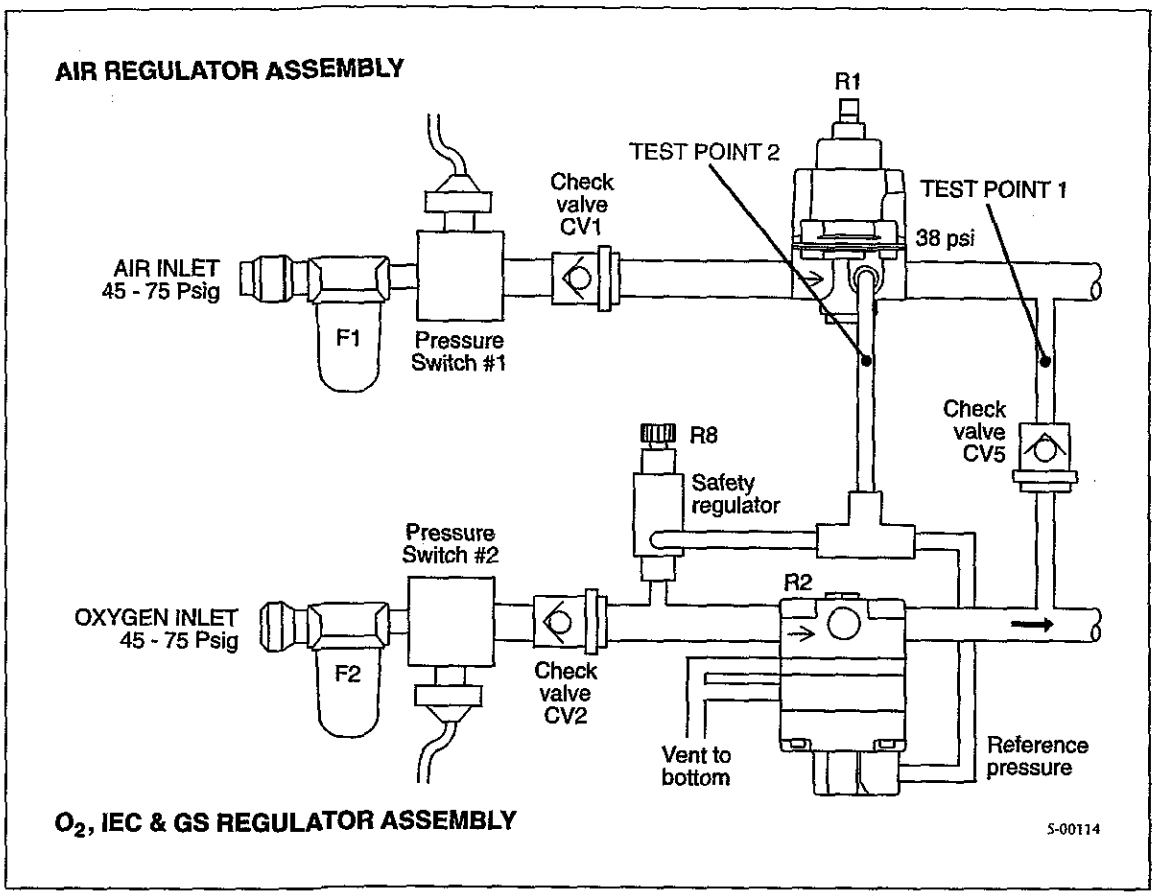


Figure 6-4. Air (R1), Oxygen (R2), and Safety (R8) Regulator Assemblies

6.3 Proportional Valve Flow Solenoids/Repair and Maintenance

Solenoids are fitted to the proportional manifold to provide a calibrated flow of gas to the patient. They are identified as SV1 (2 Lpm), SV2 (4 Lpm), SV3 (8 Lpm), SV4 (16 Lpm), SV5 and SV6 (each 16 Lpm operating together to make 32 Lpm). The Infant *Star* 950 has four additional solenoids, (2) SV11 (2) SV12, that are used for HFV. SV11 and SV12 solenoids always operate together to provide 64 Lpm.

Energizing either one or several solenoids simultaneously, provides the desired flow (even numbers from 4 - 40 Lpm). Table 6-3 lists the allowable tolerances for background flow. The background flow control knob adjusts the flow.

6.3.1 Tools, Equipment and Supplies

- O - 60 Lpm flowmeter
- patient circuit
- *Star* test lung (P/N – N-1101262)
- small strap wrench, slip joint pliers or similar
- Phillips screwdriver, No. 2
- Loctite 425 (P/N – N-4500058)
- isopropyl alcohol
- cotton swabs
- eye loop or magnifying glass
- standard tool kit
- tie wrap

6.3.2 Background Flow Control Tests

Background flow control increments, in steps of 2, between 2 - 30 Lpm (2 to 32 Lpm for software 107 and higher).

1. Before checking the flow, turn the pop-off control knob fully clockwise.
2. Using Table 6-3, measure the flow from To Patient outlet vs. background flow setting.

Table 6-3: Background Flow Allowable Tolerances

Background Flow Control (Lpm)	Measured Limits
2	1.8 to 2.2
4	3.6 to 4.4
8	7.2 to 8.8
14	12.6 to 15.4
16	14.4 to 17.6
30	27.0 to 33.0
32 (software 107 or higher only)	28.8 to 35.2

NOTE:
All solenoids have an unrestricted flow of approximately 16 Lpm. Individual solenoids may be less than, or more than, 16 Lpm. Calibration is made with a restrictor that is selected to match the solenoid and is screwed into the proportional manifold block below the solenoid. A label is affixed to the manifold listing the restrictors and their locations.

6.3.3 Flow Solenoid Malfunctions

1. A drop in PIP usually indicates an inoperative solenoid. Attach a flowmeter and measure the flow at various settings to determine which solenoid is not flowing, as indicated by a reduction of the amount of flow that would be contributed by the inoperative solenoid. For example: a setting of 12 Lpm would require the 4 Lpm and 8 Lpm solenoids to be energized; if the flowmeter shows only 4 Lpm it is an indication that the 8 Lpm solenoid is inoperative.
2. An Over pressure, as indicated by an overshoot of PIP and possible an A01 alarm, is most likely caused by a broken spider spring or debris contamination in a solenoid. If cleaning does not correct the leakage, the complete solenoid must be replaced.
3. HI-PP-A01 alarm will occur when the proximal pressure transducer has reached the High Inspiratory Pressure (HIP) setting.
4. First determine whether the alarm occurs only when the ventilator is in use on a patient or if it happens during Quick Checkout using a standard Mallinckrodt patient circuit and test lung.
5. For the patient related alarm; if it is not patient-triggered, duplicate the setup as closely as possible in the workshop using the same ventilator settings. Note that the Mallinckrodt test lung supplied with each ventilator is equivalent in compliance to a full term neonate. Bypass the humidifier and use the test lung to produce a test condition similar to that encountered with a premature neonate.
6. Patient circuits can contribute to pressure spikes. A very compliant disposable circuit that is draped in such a fashion that allows it to bounce, or together with water in the lower loops, can produce pressure spikes above set PIP.
7. Some patient circuits, by their very design, can cause AO1 alarms. One such is the *babyflex circuit*. The caution notice on the Airoflex literature says not to use the babyflex on the Infant *Star* 500/950 where flow applications exceed 15 Lpm.

8. The causes and fixes for most A01 alarms are as follows:
   - Patient is coughing or *fighting* the ventilator. This is the situation for which the alarm was created to alert the medical personnel - no repair action needed. Place patient on synchronized ventilation using *Star* Sync.
   - Additional flow is being introduced into the To Patient circuit by in line nebulization or similar. Use the mechanical relief valve to control the pressure - no repair action needed.
   - A flow solenoid has a broken spider. This prevents a positive seal when the solenoid is de-energized. Replace the solenoid.
   - A flow solenoid is dirty, preventing the pad in the center of the spider from properly sealing the nozzle. Clean and inspect the solenoid.

6.3.4 Maintenance/Procedure

1. To avoid the condition described in Section 6.3.3, step 2 above, it is recommended that the flow solenoids be disassembled and cleaned as routine preventive maintenance. A preventive maintenance cleaning of the solenoids is required at every 5000 hours of use as noted on the elapsed time indicator.
2. Place the ventilator on a table wide enough to allow the top section (electronic head and pneumatics cover) to be removed and placed behind the pneumatics base assembly. Remove the cover by unscrewing the three screws on each side of the cover. (Disconnect from gas source.)

Caution

To minimize the risk of mixing spiders between solenoids, disassemble and clean one solenoid at a time.

3. Remove the top electromagnetic head from each of the solenoids by unscrewing the knurled nut. Use a small Allen wrench or rod placed in one of the three holes in each base and hold each base while disassembling the solenoid to prevent it from turning,
4. Inspect each spider carefully using a magnifying glass if necessary. If damage is identified but the solenoid is in good mechanical condition, clean the chamber and spider spring using isopropyl alcohol, cotton swabs, and compressed air.
5. Reassemble the solenoids being sure to place the shim below the spider, even though it may have been above before.
6. With the ventilator connected to air and oxygen, but not switched ON electrically, block the vent hole in the safety vent valve (the black valve is located below the proportional manifold). In high frequency ventilators the safety vent is attached to the inner end of the manifold block.
7. Check for flow from the To Patient connector. Do this by taking a tube from this connector and putting the end into a glass of water and looking for bubbles, or attach to a 0 - 1 Lpm flowmeter, or just hold the tube to your ear and listen for flow. Any flow from the To Patient tube indicates a leaking solenoid.
8. Using an appropriate flowmeter, perform a flow test as described in the test procedures.
9. If all is in order, reassemble the ventilator and perform a Quick Checkout (Section 3) before placing it back in service. In the event that a fault persists and help is needed, call Mallinckrodt at 1-800-635-5267, press 2 for Technical Support.

6.4 Oxygen Blender Calibration

Before calibrating the oxygen blender, it is necessary to balance the air and oxygen pressures applied to the blender; see Section 6.4.2 Ventilator Set Up.

Do not change two top screws on Blender

6.4.1 Tools, Equipment and Supplies

- O_2 analyzer (MiniOx I/II or equivalent)
- Phillips screwdriver, No. 2
- Allen wrench, 0.050 inch and 1/16 inch
- open-end wrench, 1-1/8 inch, 5/8 inch, 1 inch
- flow meter, 0 to 20 Lpm
- needle-nose pliers

6.4.2 Ventilator Set Up

1. Connect an air and oxygen supply source (Figure 6-5) to the air and oxygen ports located on the rear panel of the pneumatics module.

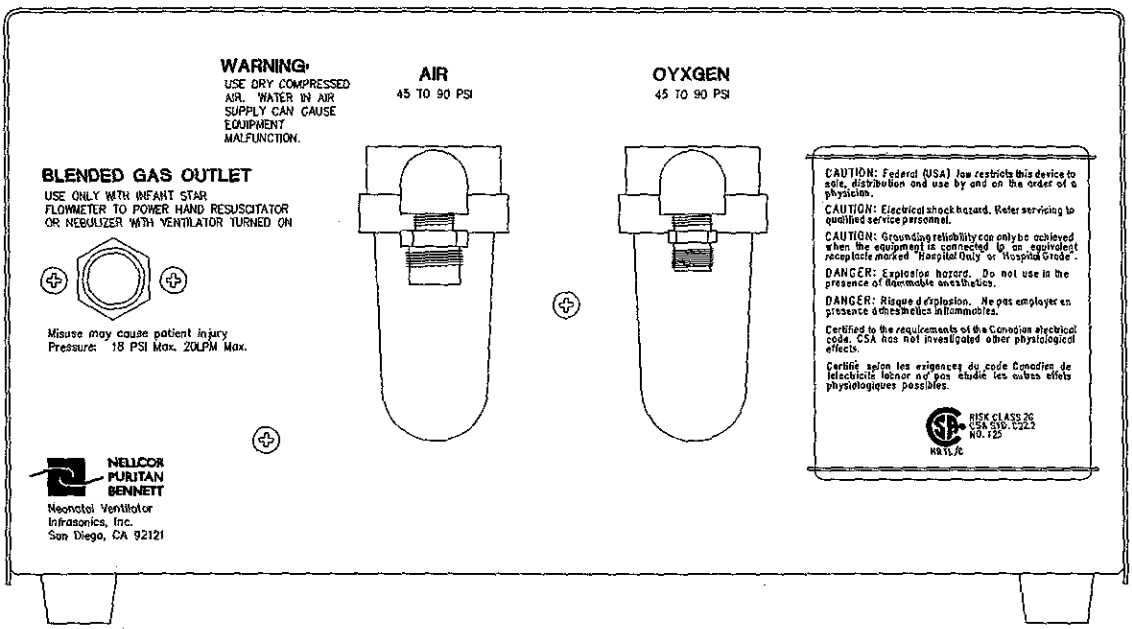

WARNING:
USE DRY COMPRESSED AIR. WATER IN AIR SUPPLY CAN CAUSE EQUIPMENT MALFUNCTION.
AIR
45 TO 90 PSI
OYXGEN
45 TO 90 PSI
BLENDED GAS OUTLET
USE ONLY WITH INFANT STAR FLOWMETER TO POWER HAND RESUSCITATOR OR NEBULIZER WITH VENTILATOR TURNED ON
Misuse may cause patient injury
Pressure: 18 PSI Max. 20LPM Max.
CAUTION: Federal (USA) law restricts this device to sale, distribution and use by and on the order of a physician.
CAUTION: Electrical shock hazard. Refer servicing to qualified service personnel.
CAUTION: Grounding reliability can only be achieved when the equipment is connected to an equivalent receptacle marked "Hospital Only" or "Hospital Grade".
DANGER: Explosion hazard. Do not use in the presence of flammable anesthetics.
DANGER: Risque d'explosion. Ne pas employer en presence d'anesthetics inflammables.
Certified to the requirements of the Canadian electrical code. CSA has not investigated other physiological effects.
Certifié selon les exigences du code Canadien de l'électricité. Isonor n'a pas étudié les autres effets physiologiques possibles.
RISK CLASS 2G
CSA STD. C22.2
NO. 125
NELLCOR PURITAN BENNETT
Neonatal Ventilator
Infrasonics, Inc.
San Diego, CA 92121

Figure 6-5. Pneumatics Base (rear view)

2. Turn on the ventilator and set the following test conditions:

Mode	CPAP
PEEP/CPAP	Fully counterclockwise (no hard stop)
Flow Rate	20 Lpm
Background Flow	16 Lpm
Ventilator Rate	30 bpm
Peak Inspiratory Pressure	40 cmH_2O
High Inspiratory Pressure	45 cmH_2O
Inspiratory Time	1 second

Low Inspiratory Pressure	30 cmH_2O
Display Select	Expiration Time
Oxygen Percent	60
Pressure Relief Valve	Fully clockwise
HFV Rate	12 Hz
HFV Amplitude	Clockwise 3 to 4 turns (no hard stop)

3. Attach a calibrated O_2 analyzer to the To Patient port on the base console of the pneumatics module. Attach one end of a 12-inch tube to the O_2 analyzer and the other end remains open to atmosphere (Figure 6-6).

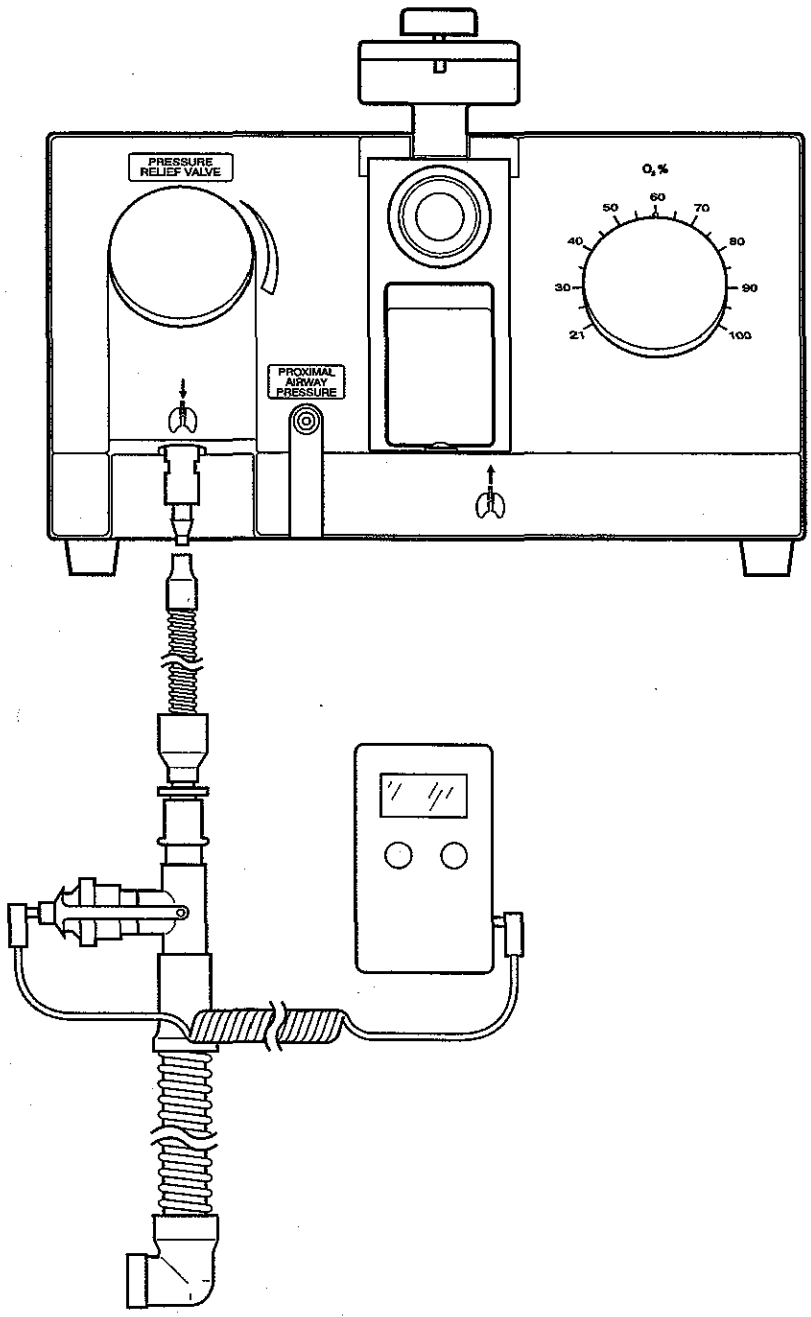


Figure 6-6. Pneumatics Base with O_2 Analyzer

6.4.3 Oxygen Blender Quick Check

Perform the following oxygen blender quick check to determine if the blender is out of calibration.

NOTE:
The following procedures make reference to a *stable* O_2 analyzer reading. Allow approximately one minute for readings to stabilize.

1. With a background flow of 16 Lpm, turn the O_2 control knob (Figure 6-9) fully clockwise to the 100 % setting. When the reading stabilizes, record the result.
2. Set the background flow to 4 Lpm; when the reading stabilizes, record the result.
3. Repeat the procedures in step 1 and 2 above to check the following oxygen settings. Record the results:

Oxygen Percent	Background Flow Settings (Lpm)
100	16 and 4
90	16 and 4
60	16 and 4
30	16 and 4
21	16 and 4

NOTE:
For each setting tested, the difference between 16 Lpm and 4 Lpm should not vary more than 1%.

4. If the difference between 16 Lpm and 4 Lpm is greater than 1%, skip to Section 6.4.3.1; otherwise, continue to step 5.
5. Compare the results of the oxygen percent readings taken in step 3 above, against the allowable ranges listed below.

Oxygen Percent	Allowable Range
100	99-100
90	87-93
60	57-63
30	27-33
21	21-22

6. If the readings are within the allowable ranges, skip to Section 6.4.4
   or
   if two or more readings are outside the allowable range, continue to Section 6.4.3.1.

6.4.3.1 Check the 0.015-inch Restrictor for an Occlusion

The restrictor is inside the restrictor housing which is located under the blender block assembly (Figure 6-7).

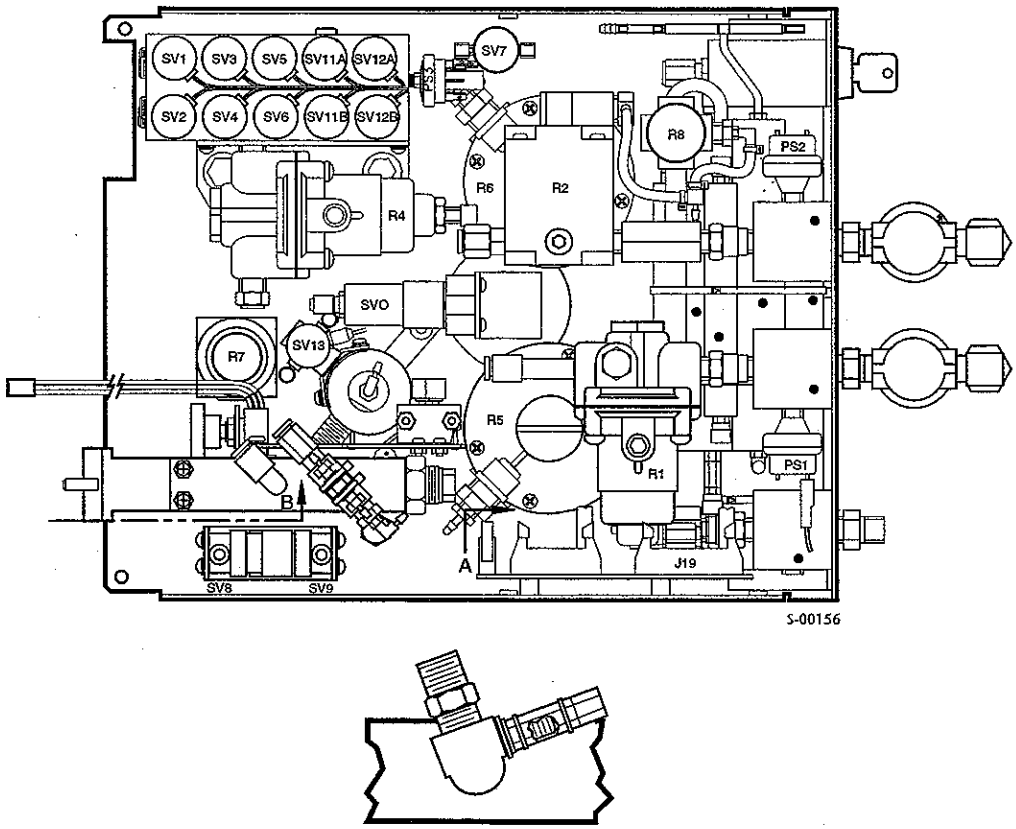


Figure 6-7. Oxygen Blender 0.015-inch Restrictor

1. Switch ventilator power OFF.
2. Attach a 20 mm ID connector to one end of a tube and the other end of the tube to a flow meter. Hold the 20 mm ID connector over the bleed port located on the bottom of the pneumatics module (front-right quadrant) under the blender assembly. Hold snug, ensuring no leaks, and measure the flow; it should read between 2.5 to 7 Lpm.
3. If the reading is within range, skip to Section 6.4.4
   or
   if the reading is below 2.5 Lpm, there may be an occlusion in the restrictor; continue to step 4.
4. To access the bleed port (Figure 6-7) on the restrictor housing, detach the base console from the pneumatics module as follows:
   a. Loosen 2 setscrews on the O_2 control knob and remove knob.
   b. Remove the 2 Phillips screws and lockwashers located behind the O_2 control knob.
   c. Remove the 2 Phillips screws, on each side of the pneumatics module, that attach the base console to the pneumatics module.
   d. Leaving all connections intact, lift the base console just enough to set the bottom of base console outside the pneumatics module, thus providing access to the restrictor housing.

5. Cut the two tie wraps that secure the silicone tube to the bleed port on the restrictor housing. Disconnect the tube and remove the restrictor. Remove any obstruction.
6. Replace restrictor by inserting the jeweled end into the bleed port. Reconnect the tubing to the restrictor and replace the two tie wraps.

NOTE:

When reattaching the base console to the pneumatics base, check to ensure that the To Patient tubing (inside the base console) is connected to the large brass barb at the bottom of the flow manifold.

---

7. Replace the base console by reversing the procedure in step 4; then continue to step 8.
8. Switch the ventilator power ON.
9. Return to Section 6.4.3 and repeat step 1 through 4 to recheck the oxygen settings. If the test fails a second time, recalibrate the oxygen regulator (R2) as described in this manual.

6.4.4 Blender Flow Control Operation

The following procedure describes how to check the blender flow control assembly for proper operation.

NOTE:

- The EMI shielded ventilator has one differential transducer PCA that provides the same functionality as two PCAs, the differential pressure and transducer, installed on older systems.
- If your ventilator has the older snap valve assembly installed instead of the newer flow control assembly (SV13 and pilot valve), contact your Mallinckrodt service representative to return the ventilator for a factory overhaul. The snap valve assembly will be replaced with the blender flow control assembly.
- When ordering an overhaul service, you will need the ventilator *serial number, part number* (on ventilator rear panel) and, *Software version* (displays when ventilator is turned ON in the bottom-left portion of screen).

---

1. Check the LED on the differential pressure PCA (DS1); it should illuminate 3-4 seconds and turn OFF momentarily when the pilot valve opens.
2. If the LED illuminates, continue to step 3
   or
   if the LED does not illuminate, check the red wire that runs from the terminal block, at pin 24, to the differential pressure PCA; ensure both ends are making contact.
3. Check the blender flow control assembly (Figure 6-8) for proper operation. Listen for the snapping sound produced by the open/close action of the solenoid/pilot valve.
4. If you hear snapping, skip to Section 6.4.5; otherwise, continue to step 5.
5. If you do not hear snapping, check for a leak at the dome by listening for a hissing sound.

6. If you hear hissing, there is a leak and the flow control assembly must be replaced
   or
   if you do not hear a hissing sound, check the following:
   a. If the ventilator has a yellow wire that runs from the terminal block, at pin 24, to the J19 connector, ensure both ends are making contact.
   b. Check for flow at the To Patient port (Figure 6-9). If there is no output, check the flow solenoids for proper operation.
   c. Check the connector at SV13 (yellow three-way solenoid valve) for a secure connection (Figure 6-8).

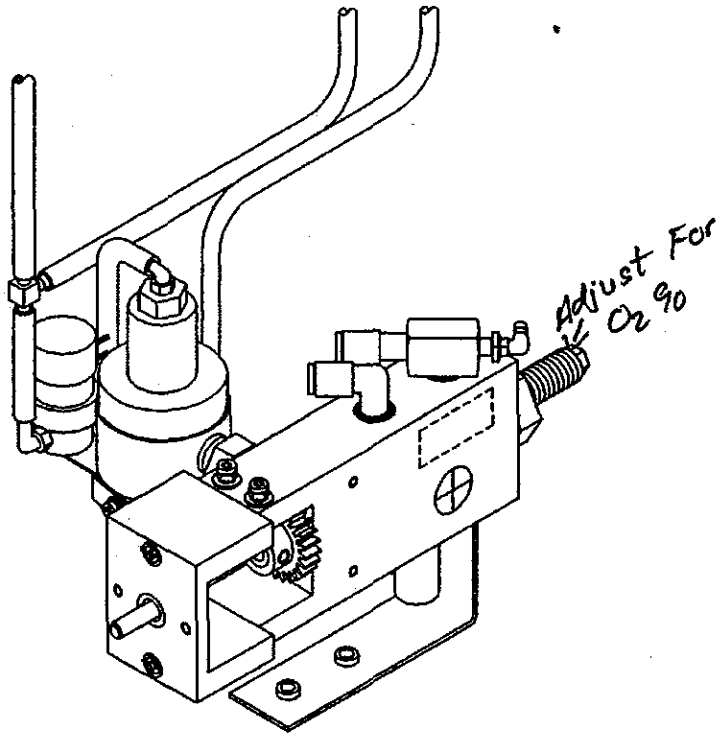


Figure 6-8. Oxygen Blender and Flow Control Assembly (SV13 and Pilot Valve)

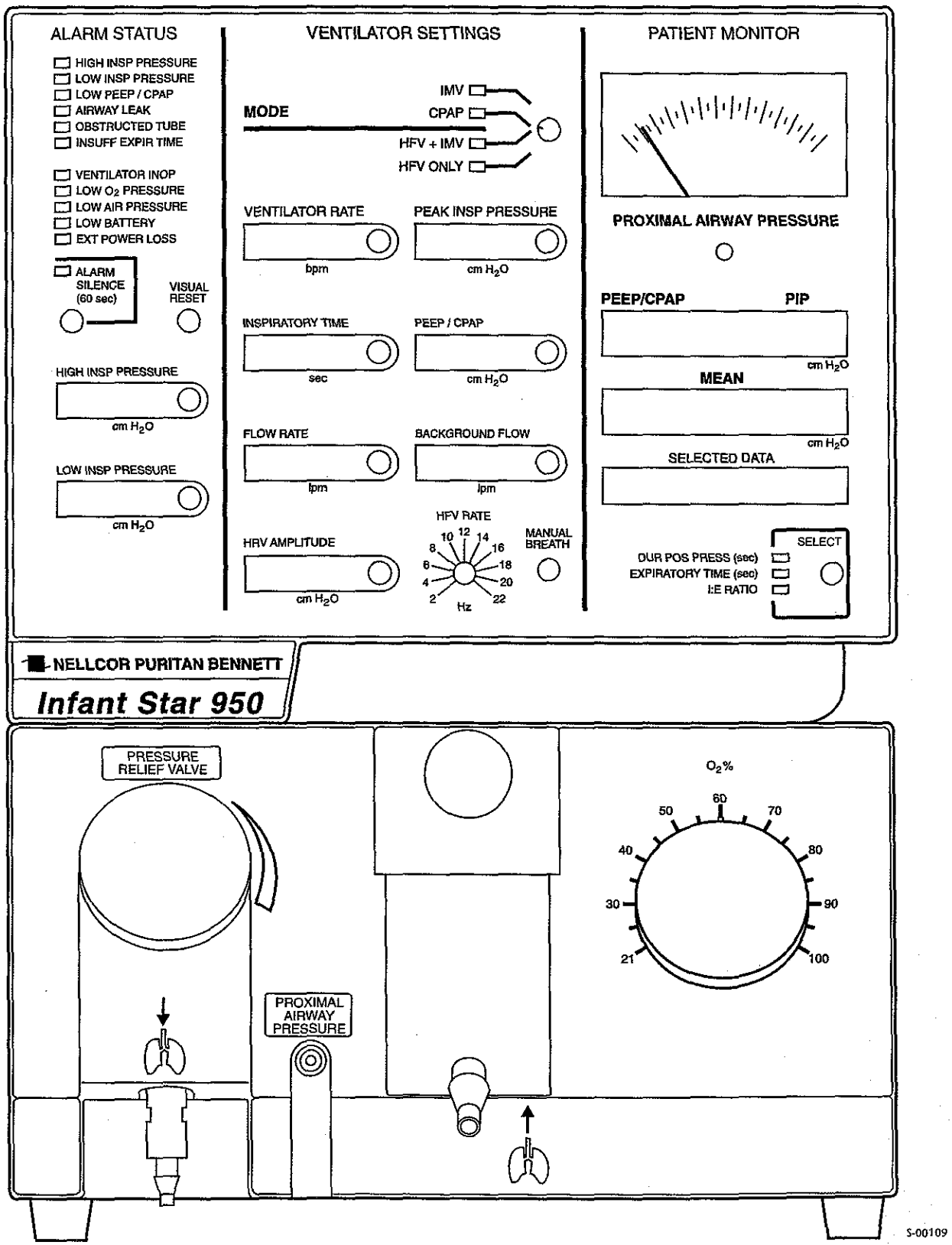


Figure 6-9. Front Panel Display/Pneumatic Controls

6.4.5 O_2 Control Knob Stop Alignment

1. Check the 21% hard stop:
   a. Turn the O_2 control knob fully counterclockwise. When checking the 21% hard stop, the mark on the knob must align with the mark representing 21% on the base console. (Marks are considered aligned if any part of one mark makes contact with the other.)

      If the marks align, skip to step 2; otherwise, continue to step 1b.

   b. Loosen the 2 setscrews on the O_2 control knob. Align the mark on the knob with the 21% mark on the base console. While holding the knob in place, and keeping a 1/8-inch gap between the O_2 control knob and the base console, retighten the two setscrews.
2. Check the 100% hard stop (Figure 6-9):
   a. Turn the O_2 control knob fully clockwise. When checking the 100% hard stop, the mark on the knob must align with the mark representing 100% on the base console. (Marks are considered aligned if any part of one mark makes contact with the other.)

      If the marks align, skip to Section 6.4.6; otherwise, continue to step 2b.

   b. Loosen the stop screw that adjusts the 100% O_2 hard stop. Align mark on the knob with the 100% mark on the base console.

   c. Retighten stop screw and nut.

6.4.6 Setting Oxygen Thresholds

NOTE:

If the ventilator is using breathing air, from a cylinder, instead of wall gas, the oxygen reading will only go to 22%; not 21%. If this is the case, follow the procedures below substituting 22 for 21.

6.4.6.1 Setting 21% Oxygen

1. Turn the O_2 control knob fully counterclockwise and set the background flow to 16 Lpm (Figure 6-10). Wait for the reading to stabilize.
2. If the reading reaches 21% ±0.9, skip to Section 6.4.6.2; otherwise, continue to step 3.
3. Loosen the setscrew on the white gear (Figure 6-8) located under the blender shaft. Continue turning the knob counterclockwise until the O_2 analyzer reads 21% ±0.9. Wait for the reading to stabilize.
4. Slowly turn the O_2 control knob clockwise until you get a stable reading of at least 22%. Then, slowly reverse the O_2 control knob (counterclockwise) until the reading stabilizes at 21.7% ± 0.1.
5. With a stable 21.7% ±0.1 reading, rotate the white gear (up) until the setscrew is up against the base of the 21% stop screw. Retighten the setscrew on the white gear.
6. Realign the O_2 control knob to the 21 setting. Loosen the two setscrews on the O_2 control knob. Align the mark on the knob with the 21% mark on the base console; then, while holding the knob in place, and keeping a 1/8-inch gap between the knob and the base console, retighten the two setscrews.

6.4.6.2 Setting 100% Oxygen

1. Turn the O_2 control knob fully clockwise and set the background flow to 16 Lpm (Figure 6-9). Wait for the reading to stabilize.

   If the oxygen percent reading reaches 100, skip to step 6
   or
   if 100 is not achieved, continue to step 2 to adjust the air inlet sleeve.

Caution

To avoid over tightening the air inlet sleeve, make all adjustments at 90%.

2. To avoid damaging transducers on the transducer PCA (Figure 6-7), remove the two screws that secure the PCA to the pneumatics module. Leaving all cables connected, lift the bottom of the PCA just outside the base.
3. Turn the O_2 control knob to 90 and wait for the reading to stabilize.
4. Slip a 5/8-in. open-end wrench over the air inlet sleeve (Figure 6-8). While facing the front of the pneumatics base, tighten the air inlet sleeve by turning the wrench 20 degrees counterclockwise.

   If the wrench will not turn, complete steps 4a and 4b; otherwise, skip to step 5.

   a. Slip a 1-in. open-end wrench over the blender block assembly to hold it stable.
   b. While stabilizing the block assembly, slip a 1-1/8-in. open-end wrench over the nut (Figure 6-8) turning clockwise to slightly loosen (just enough to take pressure off sleeve).
5. Turn the O_2 control knob clockwise to 100 and wait for the reading to stabilize. If 100% ±0.2 is achieved, continue to step 6; otherwise, return to step 3.
6. Check the 60 oxygen percent reading by turning the O_2 control knob to 60. Wait for a stable reading of 60% ±3.

   If the reading is within range, skip to step 8; otherwise, continue to step 7.
7. Adjust the air inlet sleeve, no more than 20 degrees, then repeat step 6.

NOTE:

- If the oxygen readings are too low, turn the air inlet sleeve *counterclockwise.*
- If the oxygen readings are too high, turn the air inlet sleeve *clockwise.*

If the desired reading is achieved, continue to step 8; otherwise, repeat this step until the desired oxygen reading is achieved.

8. Check the 90% reading by turning the O_2 control knob to 90. Wait for a stable reading of 90% ±3.

   If the reading is within range, skip to step 10; otherwise, continue to step 9.
9. Adjust the air inlet sleeve, no more than 20 degrees, and wait for the reading to stabilize.

NOTE:

- If the oxygen readings are too low, turn the air inlet sleeve *counterclockwise.*
- If the oxygen readings are too high, turn the air inlet sleeve *clockwise.*

If the desired reading is achieved, continue to step 10; otherwise, repeat this step until the desired oxygen reading is achieved.

10. Retighten the nut on the air inlet sleeve (Figure 6-8) if it was loosened. Continue to step 11.
11. Reinstall the transducer PCA and replace the two screws that secure the PCA to the pneumatics module. Continue to Section 6.4.7.

6.4.7 Verify Oxygen Readings

1. Once the high and low oxygen thresholds are established, check the following oxygen settings in the order listed below. Record the results.

Oxygen Percent	Background Flow Settings (Lpm)	Allowable Range
100	16 and 4	99-100
90	16 and 4	87-93
60	16 and 4	57-63
30	16 and 4	27-33
21	16 and 4	21-22

If the above oxygen control readings are within range, continue to step 2; otherwise, return to Section 6.4.6.

2. Reverse the above process (starting at 21% oxygen up to 100% oxygen) and record the results.
3. If any of the above oxygen readings are outside the allowable range, return to Section 6.4.6.

6.5 Oxygen Blender Potentiometer Calibration

This section describes the calibration and testing of oxygen blender potentiometers on Infant *Star* 500/950 ventilators.

1. Turn power to the ventilator ON and Select the I:E Ratio window display by pressing the select switch. Enter the Diagnostics display window by pressing Alarm Silence and Visual Reset simultaneously until "--1" appears in the corresponding window. Press Alarm silence until position "--2" appears, this is the 0_2 potentiometer position reading.
2. Verify that the diagnostic display window corresponds to oxygen blender settings at 21, 30, 90, 100 ±2%. If the reading(s) in the Diagnostic window are not within limits, follow the calibration procedure below:
3. Locate the oxygen blender potentiometer on the left side of oxygen blender. Loosen Allen-head screws on the shaft of white plastic gear.
   a. Slide white gear forward so that it disengages from mating gear on the blender shaft. At this point the white gear should rotate loosely on the shaft. Rotate gear so that Allen-head screws can be easily retightened without rotating the gear.
   b. Set the front panel oxygen blender setting to read 60% oxygen. Using a pair of long needle-nose pliers, rotate the potentiometer shaft until the display reads "60." Carefully place the white gear back into position on mating gear. Use care not to move potentiometer shaft while reinstalling the gear, it may help to grasp shaft with long-nose pliers to prevent movement. Tighten the retaining Allen-head screws on the white gear securely.

c. Verify that with gear reinstalled, the 0_2 position window reads 60% with the oxygen blender knob set to 60%. If display is not correct, repeat step 3b.

d. Verify that diagnostic display window corresponds to oxygen blender settings at 21, 30, 90, 100 ±2 percent.

6.6 PEEP/CPAP Needle Valve Adjustment

1. Select the CPAP Standard Test Conditions mode, set the background FLOW RATE control to 8 Lpm and the PEEP/CPAP SETTING control to 20 cmH_20. Press the display selection knob to the I:E RATIO SETTING position.
2. Select display of the Servo Correction Factor on the data select display (located above the display selection knob) by simultaneously depressing the ALARM SILENCE and VISUAL RESET buttons until ":--1" is displayed. There are six choices of data that can be displayed in this mode (each identified ":--" followed by a number). If ":--1" is not displayed, it may be necessary to cycle through the other selections. This may be accomplished by depressing the ALARM SILENCE button as many times as required to cycle to a display of ":--1." Wait a few seconds and verify that the ":--1" is replaced by the actual Servo Correction Factor, which is a number from -18 to +18.
3. Before adjusting the PEEP/CPAP needle valve, ensure that the pneumatics have had time to warm up by placing the pneumatics cover on the unit for at least 5 minutes.
4. Ensure that the Flow Rate is set to 8 Lpm and the PEEP/CPAP setting is set to 20 cmH_20. Adjust the PEEP/CPAP needle valve for a reading of between -4 and -8 on data select display as described below:
   a. Turn the needle valve *clockwise* to reduce PEEP or *counterclockwise* to increase PEEP.
   b. Turn ventilator power OFF after a stable PEEP reading of 20 cmH_20 of PEEP displays in the digital proximal window and a -4 to -8 servo correction reading. Reconnect the gases. Turn the ventilator power ON and verify that the PEEP/CPAP reading stabilizes at 20 and the Servo correction factor stabilizes at a reading of between -4 and -8. If not, repeat step 4a. If after repeating 4a, the PEEP/CPAP reading and Servo correction factor has not stabilized, check the internal PEEP circuit for leaks. Follow the tube from the needle valve throughout the entire pneumatic assembly. (Reference the pneumatic diagram in Section 7 of this manual.) If you find a leak, tighten or replace the part and repeat step 4a.

6.7 Proximal Pressure Transducer Calibration

A VENT INOP E01 or E23 through E30 condition may be caused by the proximal pressure transducer signal > +0.005 Vdc with no pressure output from the ventilator.

6.7.1 Tools, Equipment and Supplies

- digital multimeter or millivolt meter
- Phillips screwdriver, No. 2
- small-slot screwdriver or trimpot adjuster tool
- torque seal lacquer or similar
- patient circuit
- *Star* test lung (P/N – N-1101262)

1. With the ventilator connected to a gas source, turn electrical power ON, connect a patient circuit and test lung. Then, connect a meter (set to read dc millivolts) to the analog output jacks on the rear cover of the ventilator.

Mode	CPAP
PEEP/CPAP	Fully Counterclockwise
Flow Rate	20 Lpm
Background Flow	4 Lpm
Ventilator Rate	30 bmp
Peak Inspiratory Pressure	40 cmH_2O
High Inspiratory Pressure	45 cmH_2O
Inspiratory Time	1.0 second
Low Inspiratory Pressure	30 cmH_2O
Display Select	Expiration Time
Oxygen Percent	60
Pressure Relief Valve	Fully clockwise
HFV Rate	12 Hz
HFV Amplitude	Fully clockwise 3 - 4 turns (no hard stop)

2. Verify zero pressure in the PEEP/CPAP and Mean Airway Pressure displays.
3. Disconnect the proximal pressure tube at the proximal airway connector at the front of the ventilator. Verify the voltmeter reading. If the voltage is not zero +0.005 Vdc, continue to step 4.
4. Remove the 3 screws from each side of the pneumatics section cover. Lift the cover off to gain access to the pressure transducer PCA.

   Locate trimpot R3 (below the J7 connector - Figure 6-10).

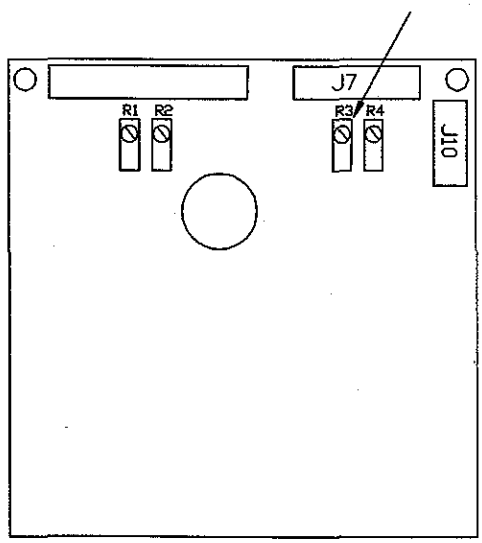


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Figure 6-10. Proximal Pressure Transducer Adjustment

5. Using a small jeweler's screwdriver or trimpot adjuster tool, adjust R3 to obtain a zero volts reading. Do not touch any other trimpot except R3.
   a. Connect the proximal pressure tube to the proximal airway connector. Verify that the voltage stabilizes within the acceptable range (0 + 0.005 Vdc).
   b. Set PEEP/CPAP to 10 cmH_2O. (Verify that the voltmeter reads 0.100 Vdc + 0.005 Vdc.)
   c. Set PEEP/CPAP to 20 cmH_2O. (Verify the voltmeter reading 0.200 Vdc + 0.005 Vdc.)
   d. Seal the trimpot with torque seal lacquer. Install the pneumatics section cover, being careful not to pinch any wires or ribbon cables.
   e. Perform the Quick Checkout to assure correct performance. If it is not possible to satisfactorily adjust the R3 trimpot or if a VENT INOP E23 through E30 persists, replace the pressure transducer PCA (P/N – N-1101163).

6.8 Venturi Needle Valve Adjustment

This procedure applies to ventilators with venturi needle valves:
Infant *Star* 500 – 35 psi and Infant *Star* 950 only.

1. Before adjusting the VENTURI needle valve, ensure that the pneumatics have had time to cool to room temperature by having the pneumatics unit cover removed for at least 15 minutes or by leaving ventilator power OFF for 1/2 hour or longer with the pneumatics unit cover in place.
2. Select display of the Servo Correction Factor on the data select display (located above the display selection knob) by simultaneously depressing the ALARM SILENCE and VISUAL RESET buttons until":--1" is displayed. There are six choices of data that can be displayed in this mode, each identified ":--" followed by a number.)
3. If ":--1" is not displayed, it may be necessary to cycle through the other selections. This may be accomplished by depressing the ALARM SILENCE button as many times as required to cycle to a display of ":--1". Wait a few seconds and verify that the ":--1" is replaced by the actual Servo Correction Factor, which is a number from -18 to +18.
4. If your Infant *Star* 500/950 ventilator is installed with Alarm Driver PCA P/N – N-1101162, adjust the venturi needle valve as described below; otherwise go to step 5.
   a. Select the CPAP mode, set the Background Flow to 32 Lpm (or 30 Lpm for software earlier than version 107) and the PEEP/CPAP to 0 cmH_2O.
   b. Adjust the venturi needle valve so that the Servo Correction Factor is 6 ±1. Allow ventilator to operate at this setting for a minimum of 2 minutes. Verify that the Servo Correction Factor remains stable at this reading.
5. If your Infant *Star* 950 ventilator is installed with Alarm Driver PCA P/N – N-1175017, adjust the venturi needle valve as described below:
   a. Connect the HFV breathing circuit P/N – N-501023, test lung P/N – N-1101262 and Fisher & Paykel MR320 Humidifier with heater wire to the ventilator.
   b. Select the HFV Only mode. Set HFV Amplitude to maximum, HFV Rate to maximum, and PEEP to 10 cmH_2O.
   c. Adjust the venturi needle valve until the Servo Correction Factor shows between -12 and -16. Allow the ventilator to operate at this setting for at least 2 minutes. Verify that the Correction Factor remains stable at this reading.
   d. Verify that the Servo Correction Factor in CPAP mode at 0 cmH_2O PEEP and 32 Lpm Background Flow to be between -16 and +16 with a standard breathing circuit (P/N – N-501011) and test lung (P/N – N-1101262).

Check the type of Servo Correction Factor the Unit uses to determine Proper Calibration

e. Ventilators with high venturi flow (Servo Correction Factor greater than 16), repeat step 4 or 5 above except adjust the needle valve until PEEP display reads 10 cmH_20, Mean Airway Pressure display reads 10.4 cmH_20 and Servo Correction Factor is –18. Verify that the Servo Correction Factor in CPAP mode at 0 cmH_2O PEEP, 32 Lpm Background Flow to be between –16 and +16 with a standard breathing circuit.

f. Ventilators with low venturi flow (Servo Correction Factor less than –16), adjust the venturi needle valve until the Servo Correction Factor is between –14 and –16. Verify that Servo Correction Factor remains stable at this reading.

Verify that the ventilator can maintain the 20 cmH_2O PEEP at settings of 20 cmH_20 PEEP, maximum HFV Amplitude, and maximum HFV Rate.

6. Apply Threadlock to venturi needle valve adjusting screw.

6.9 Analog Meter Potentiometer Adjustment

1. Connect air and oxygen high-pressure lines to the air and oxygen inlets located at the back of the ventilator.
2. Connect the air and oxygen high-pressure lines to the wall-air and wall-oxygen outlets.
3. Attach patient circuit and test lung to the ventilator.
4. Before powering on the ventilator, check the analog meter reading. If the needle is at 0 cmH_2O go to step 5
   or
   if the analog needle is *not* at 0 cmH_2O, perform the following:
   a. Remove the plastic button.
   b. Insert a trim pot tool or small screwdriver into the orifice and *carefully* rotate the tool to adjust the needle to 0 cmH_2O.
   c. After the adjustment has been made, replace the plastic button.
5. Power on the ventilator and set the following test conditions:

Mode	IMV
Ventilator Rate	15 bpm
Peak Inspiratory Pressure	40 cmH_2O
Inspiratory Time	2.0 seconds
PEEP/CPAP	0 cmH_2O
Flow Rate	20 Lpm
Background Flow	4 Lpm
High Inspiratory Pressure (alarm)	45 cmH_2O
Low Inspiratory Pressure (alarm)	Set to minimum value
Pressure Relief Valve	Fully clockwise
Oxygen Percent	60

6. Using a Phillips screwdriver, remove the screws holding the rear panel to the ventilator. If the ventilator is equipped with *Star* Sync standoffs, use a 1/4-inch box or open-end wrench to remove them.

Warning

An electrical shock hazard is present inside the ventilator cabinet when the Vac power is connected, even though the power switch is in the OFF position. Always take appropriate safety precautions to avoid accidental shock.

Caution

Be sure to follow electrostatic discharge control (ESD) procedures.

7. Pull back the rear panel to expose the electronics. You *do not* need to remove the rear panel.
8. Locate the Analog PCA (fourth board from the top) and the Analog Meter gain potentiometer R76 (Figure 6-11).

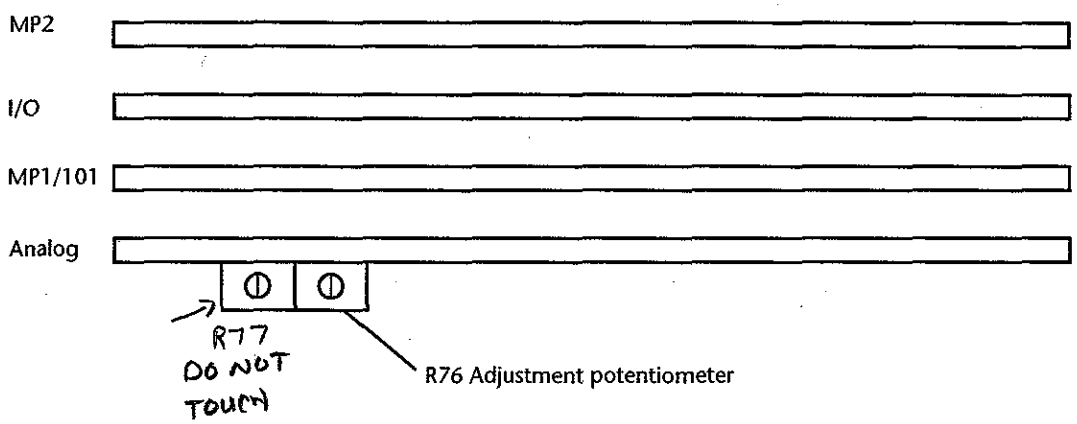

Figure 6-11. Analog PCA and Analog Meter Gain Potentiometer

9. Insert a trim pot tool into R76 and while facing the front of the ventilator, adjust R76 until the analog meter needle reaches 40 cmH_2O during the Inspiratory phase of the breath cycle.
10. After completing the adjustment, reinstall the rear cover and run Quick Checkout as described in Section 3.

6.10 Replace Alarm Battery

A nicad alarm battery is mounted to the Alarm Driver PCA which is located behind the Front Panel Display. To access the PCA the Front Panel Display must be detached.

1. Remove the 4 screws (or 2 screws and 2 front standoffs with *Star* Sync attached) that secure the Front Panel Display to the ventilator.

NOTE:

Facing the front of the ventilator, the alarm battery is mounted in the lower-left corner of the Alarm Driver PCA.

2. To remove the battery, the Front Panel Display must be moved aside to allow access to the Alarm Driver PCA:
   a. Disconnect ground.
   b. At the back of the Front Panel Display PCA, disconnect the connector (with yellow leads) coming from the back of the Alarm Driver PCA.
   c. Disconnect the connector at J28 (to the right of the battery) on the Alarm Driver PCA.
3. Without disconnecting the ribbon cables, move the front panel display to the right side of the ventilator to gain access to the Alarm Driver PCA.
4. Cut the tie wraps that secure the battery in place.
5. Cut the leads on each side of the battery. Remove battery and dispose of appropriately.

Caution

A tape/adhesive is used to secure the battery to the PCA. When removing tape residue, take care not to damage any electrical traces on the PCA.

6. Carefully remove any tape/adhesive residue from the Alarm Driver Board. Do not damage electrical traces.
7. Unsolder and remove the electrical lead ends (battery leads) from the hole on the PCA.

Caution

Before installing the new battery, take note of the polarity (– +) marked on the PCA.

8. Remove the backing paper from the double-sided tape attached to the new battery.
9. Position the battery to the correct polarity, with double-sided tape facing the PCA, and gently press into place.
10. Secure the battery with a new tie wrap.
11. Solder the electrical leads to the holes and cut excess leads.
12. Reconnect the front panel display:
    a. Reconnect the connector to J28 (to the right of the battery) on the Alarm Driver PCA.
    b. Reconnect ground.
    c. Reconnect the connector with the two yellow leads (from the back of the Alarm Driver PCA) to the back of the Front Panel Display PCA.
13. Replace the Front Panel Display by using the original hardware (4 screws or 2 screws and 2 standoffs) to secure it to the ventilator.

SECTION 7

Schematics

7.1 Printed Circuit Board Functionality, Schematics, and Circuit Diagrams

7.1.1 Introduction

The following is intended to familiarize you with the internal electronic hardware structure.

Its sole purpose is to help you troubleshoot a defective printed circuit assembly (PCA).

Once the unit has been troubleshot and the defective subassembly identified, substitute and exchange assembly or contact Mallinckrodt at 1-800-635-5267, press 2 for Technical Support.

NOTE:

Part numbers are for convenience of identifying components and are not intended to be used to order parts, as they may not be accurate with the latest part number for a given component. When ordering parts, numbers should be verified in the latest Price List or by contacting Mallinckrodt Technical Service.

There are nine printed circuit assemblies (PCAs) in the Infant *Star* 500/950 ventilators.

- Power Supply PCA P/N – N-1101160
- Analog PCA P/N – N-1175040
- Front Panel PCA P/N – N-1150012
- MP101 PCA P/N – N-1101345
- MP2 PCA P/N – N-1101156
- I/O (Input/Output) PCA P/N – N-1101157
- Alarm Driver PCA P/N – N-1101162
- Pressure Transducer PCA P/N – N-1101163
- Differential Pressure PCA P/N – N-1101186

Ventilators with a CE mark have a different Alarm Driver and a Proximal/Differential PCA that performs the same function as the Pressure Transducer and Differential Pressure PCAs listed above. They are:

- Alarm Driver PCA P/N – N-1175017
- Proximal/Differential PCA P/N – N-1175018

7.1.2 Power Supply PCA

The Power Supply PCA (P/N – N-1101160) produces the following voltages:

- 8 Vdc
- +10 VP, + VA
- +5 VA, +5 VD
- +2 Vdc
- +3 Vdc

Voltages with subscript "A" are used for analog applications, while those with "D" are digital in nature. "P" represents power.

The Power Supply PCA can be powered from three different sources:

- ac
- internal battery
- external battery

When under battery power, the supplies run from the Batt(+) and Batt(-) connections; when under ac power, a charging voltage of 11.75 Vdc is supplied to Batt(+) and Batt(-).

When controlled by an ac source, 14 to 18 Vac comes from the transformer to bridge rectifier (BR1), it is converted to a 13.5 to 16 Vdc source that feeds the Ref and Battery charger circuit thus providing the following:

- a +11.75 Vdc supply for battery charging and for further voltage synthesizing
- internal battery usage indication
- charge current

The 11.75 V at Batt+ and Batt- are connected to the 10 VP circuitry and the +10 VA voltage. This circuitry consists of Q1, Q3, Q7, Q6, and its associated circuits. Also included is over-current protection which disables these voltages when excessive current is drawn by either supply. The Batt(+) slaves the +5 VD slaves the +5 VA, the 3.0 Vdc and the voltage monitor circuits. The 5 VA acts as the source for the +2 Vdc supply.

The voltage monitor circuit consists of a wired or configuration with the 2 V, 10 V batt and 3 V supplies as inputs and a logic high at PS OK signal when all supplies are functional. When one voltage, or one that is derived from, becomes defective, the PS OK signal becomes a logic 0. This should cause a Vent Inop alarm to occur.

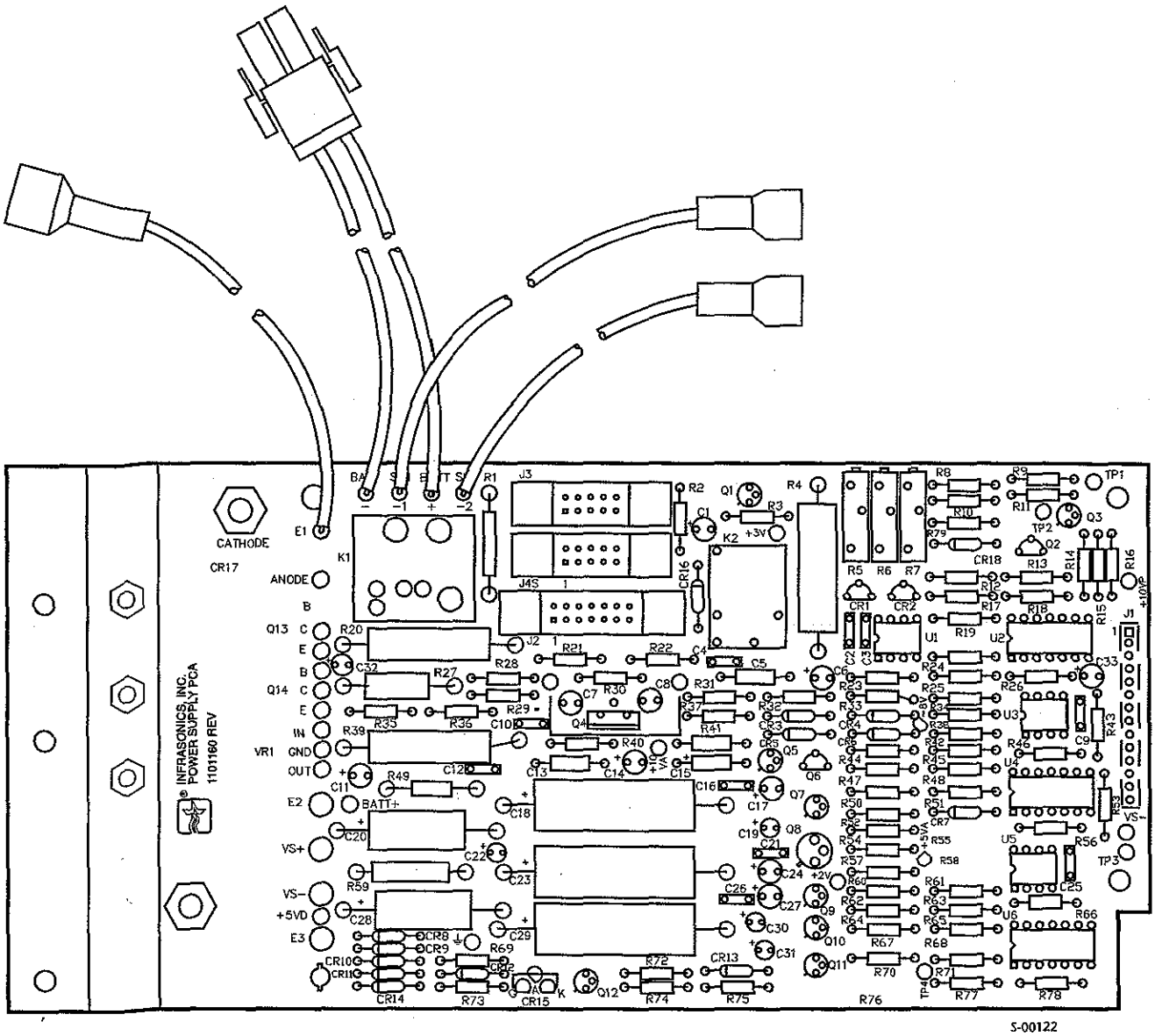

Figure 7-1. Power Supply PCA

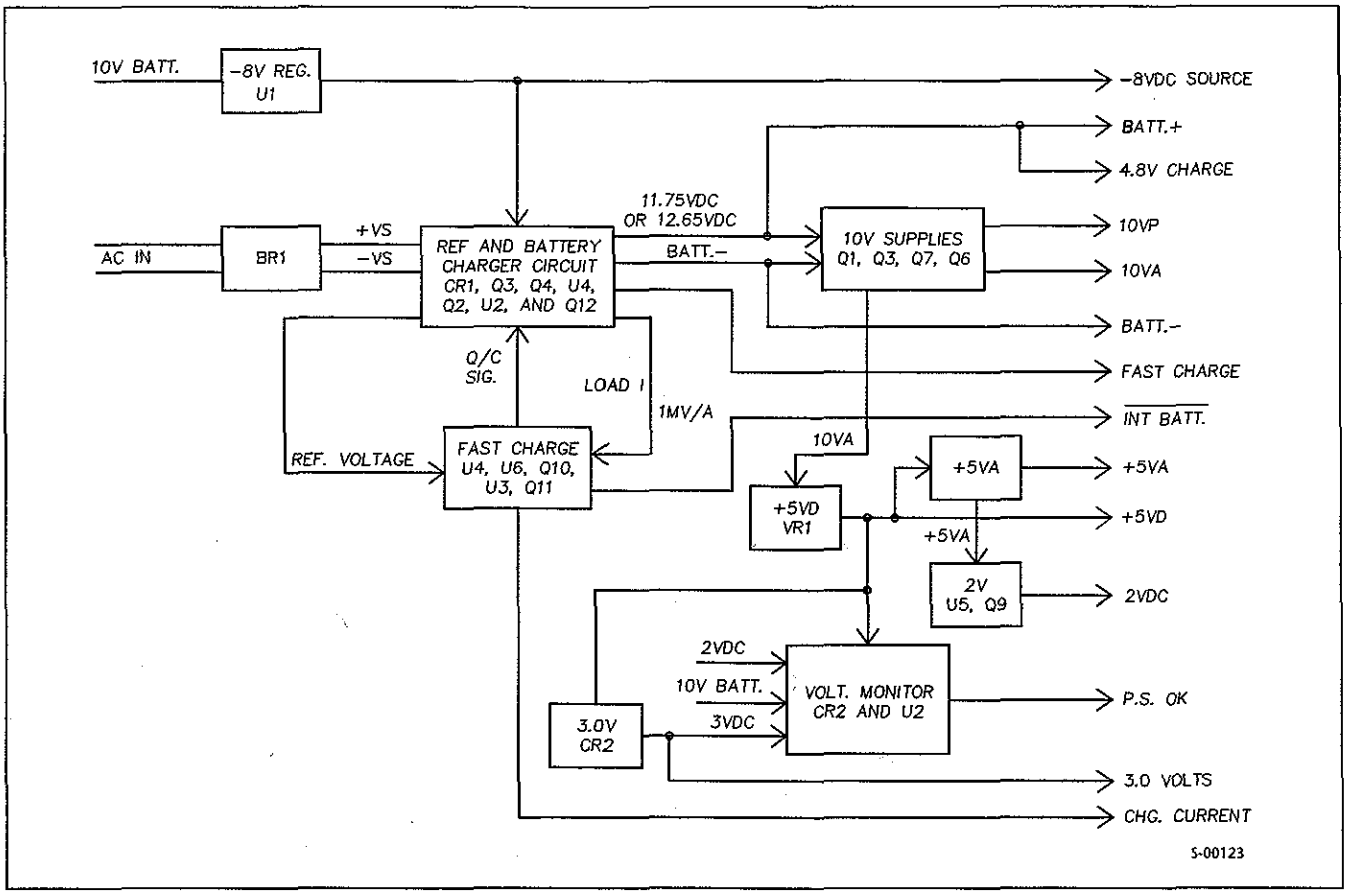

Figure 7-2. Power Supply PCA Block Diagram

7.1.3 Analog PCA

The Analog PCA (P/N – N-1175040) converts analog signals to digital words to be used by the MP101 PCA. It drives the meter and detects PIP +10 cmH_2O overpressures.

The MP101 provides address control to the analog PCA through U16. The output buss of U16 is split as follows:

- Q0-Q3: used in controlling inputs to the A/D converters
- Q4: used for PIP +15 OK gating
- Q5-Q7: provides for control of the meter circuit and auto zeroing

PT2 from the transducer PCA is split into two circuits: the meter circuit and the analog switch U10 that is addressed to provide various levels of input to AD1 and AD2.

When PT2 is connected to the meter circuit, it conditions the auto zeroing for +3 cmH_2O at initialization of the unit. It is also converted to both an analog reading, to be used by the FP meter (meter+ and meter-), which can be adjusted by the R76 trim pot and a digital reading (meter volts input) for use by the MP101 and MP2 PCAs. Various inputs are conditioned for usage off the PCA by ADO through the 16:1 Mux chip U11. The accuracy of the A/D conversion is stabilized by the 1.5 V reference which is adjustable by R77 developed from the 3 Vdc supply.

PIP +10 OK circuits compare PT1 to the Peak Inspiratory Pressure set on the Front Panel for detection of PIP +10 OK.

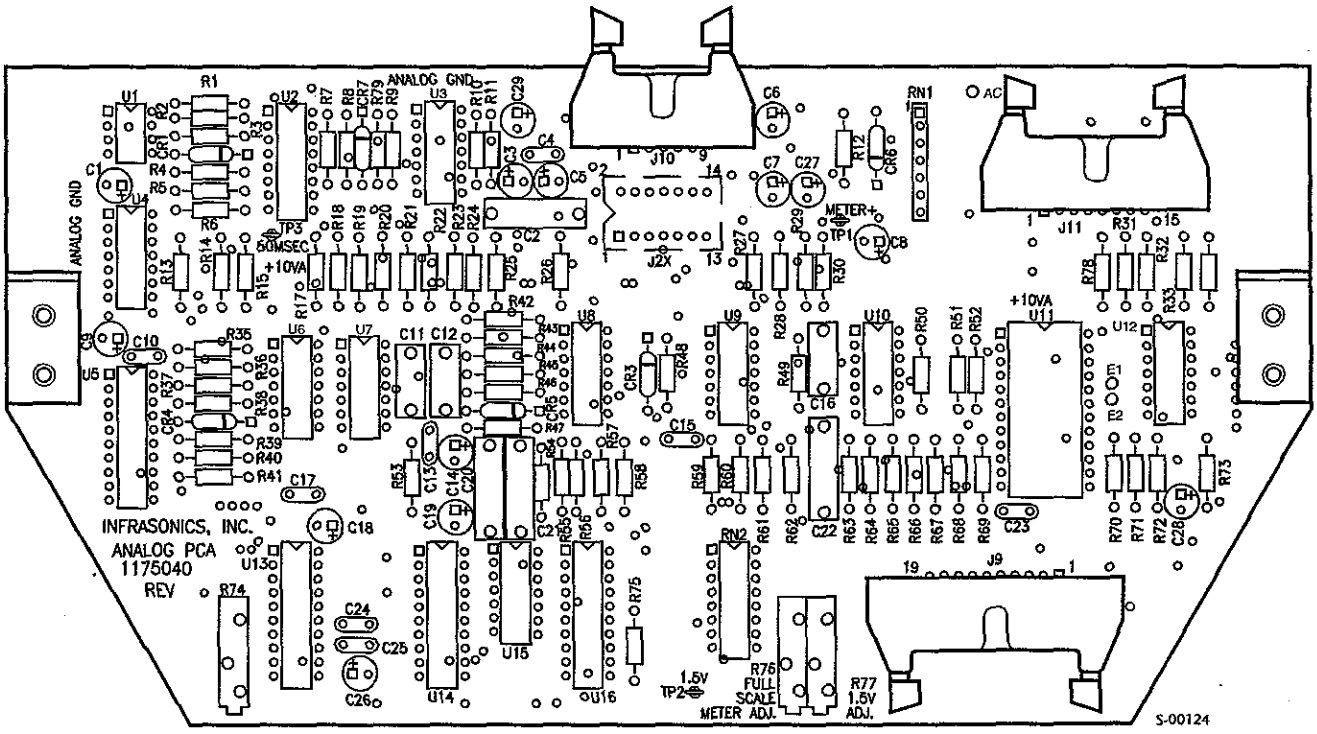

Figure 7-3. Analog PCA

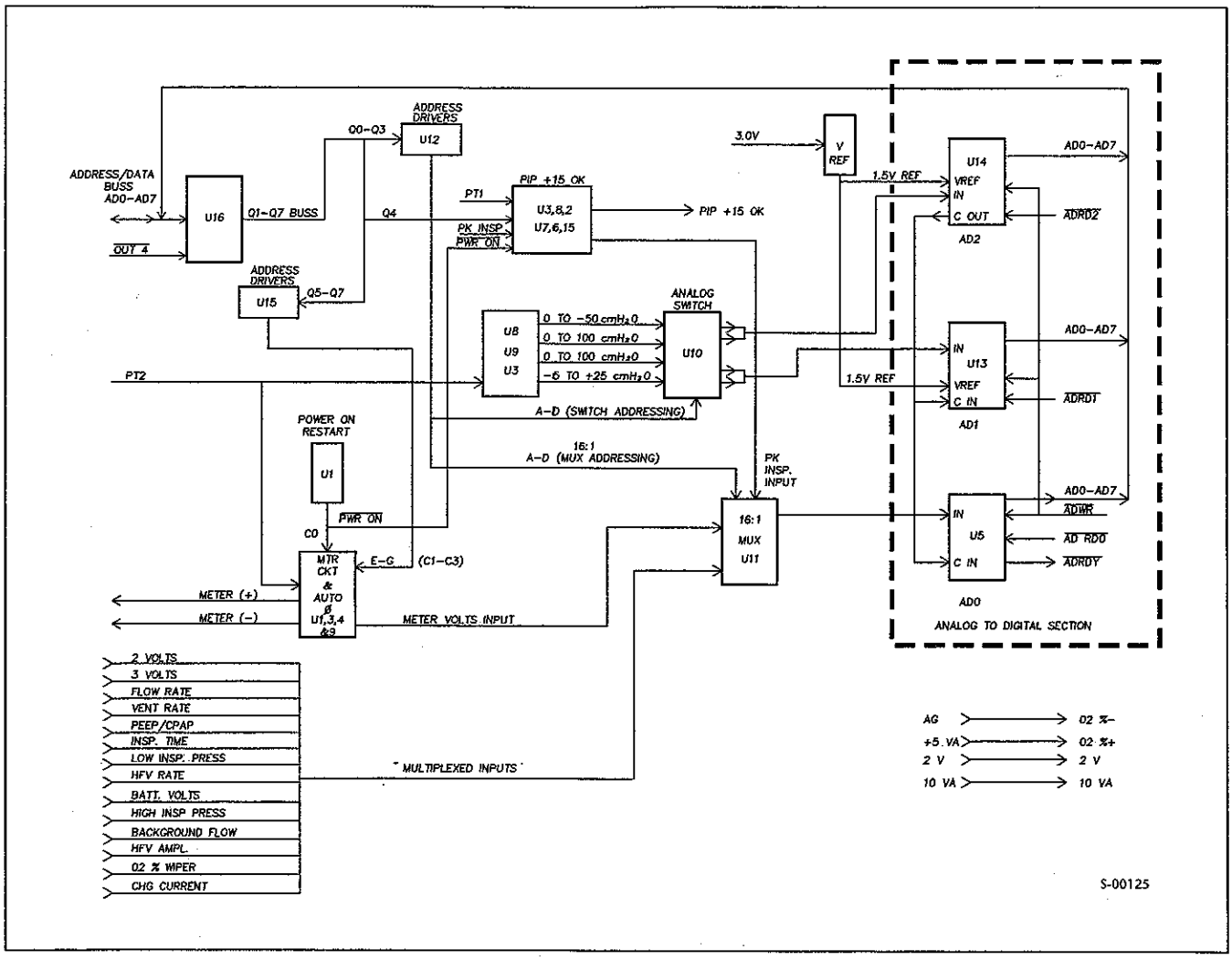

Figure 7-4. Analog PCA Block Diagram

7.1.4 MP2 PCA

The MP2 PCA (P/N – N-1101156) uses a 8085 microprocessor and a standard buss configuration consisting of RAM and ROM to provide for various program functions. Some of these functions are:

- UART control
- output port selection decoding
- input port selection decoding

Conversion of L0-L7 information from the I/O PCA to buss driver information, BD0-DB7 for use in the front panel.

Functional control information decoding during In 1 and In 2.

Output control of program functions from U10 during Out 5.

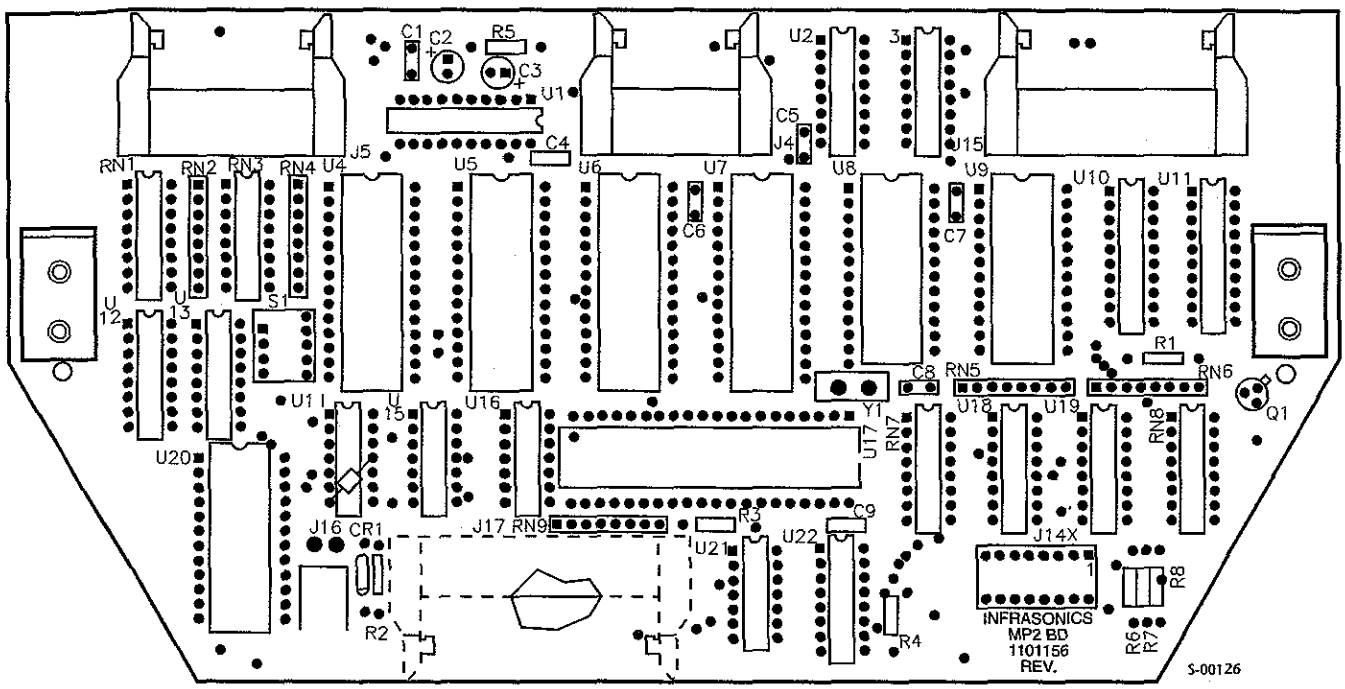

Figure 7-5. MP2 PCA